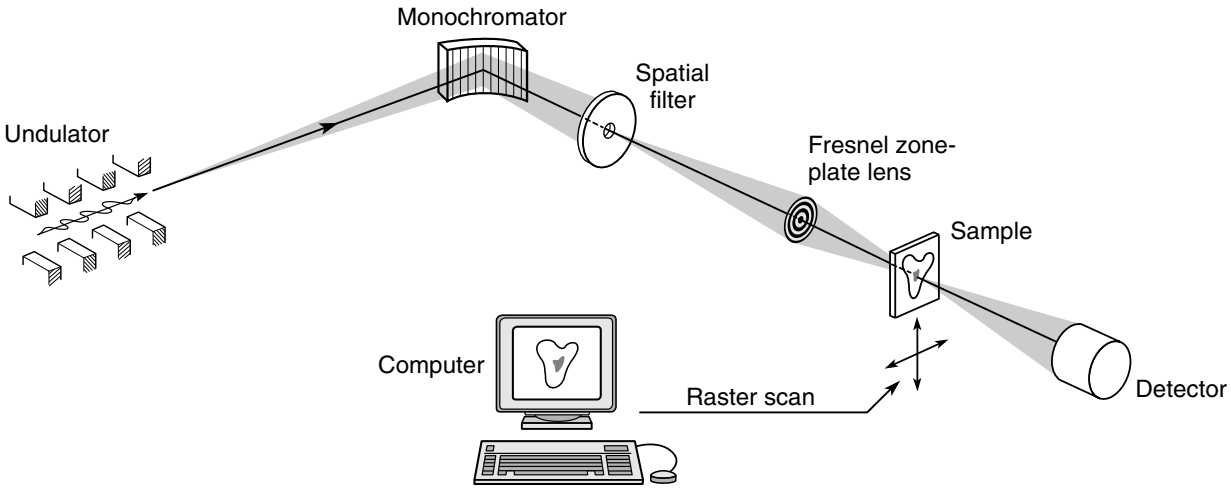
Scanning Transmission X-Ray Microscopy (STXM) • Beamline 7.0.1

Berkeley Lab • University of California

Endstation Specifications

Photon Energy Range (eV)	Photon Flux (photons/s/0.1% BW)	Spectral Resolution (E/ΔE)	Spatial Resolution (nm)	Samples	Availability
180 – 900	**~10^7** (typical count rate for transmitted photons)	**3000** (typical) **5000** (optimized)	**100 nm** (with absorption contrast)	**Wet or Dirty Thin Sections** (in helium atmosphere)	**NOW**



Schematic layout of the STXM endstation.

Beamline 7.0.1 serves several experimental stations collectively comprising "The Spectromicroscopy Facility." The scanning transmission x-ray microscope (STXM) on Beamline 7.0.1 performs near-edge x-ray absorption fine-structure spectroscopy (NEXAFS) of microscopic areas in thin samples and makes absorption-contrast x-ray images. Separate data sheets describe a scanning photoemission microscope (SPEM) and an UltraESCA station that shares beamtime with STXM and SPEM by means of deflection mirrors.

STXM uses a Fresnel zone-plate lens to produce a demagnified image of the diffraction-limited undulator radiation filtered through a pinhole. Zone plates currently in use produce a spot size of 100 nm FWHM diameter with a focal length of 3.8 mm for carbon K-edge measurements at a photon energy of 300 eV. (Future lenses will offer smaller spot sizes.) An order-sorting aperture is employed on the optical axis approximately 300 μm up stream of the sample. An x-y translatable stage rasters the sample transversely through the fixed beam at the zone-plate focus. A photon-counting detector behind the sample records the intensity of the transmitted radiation, thereby generating an image pixel by pixel during the rastering.

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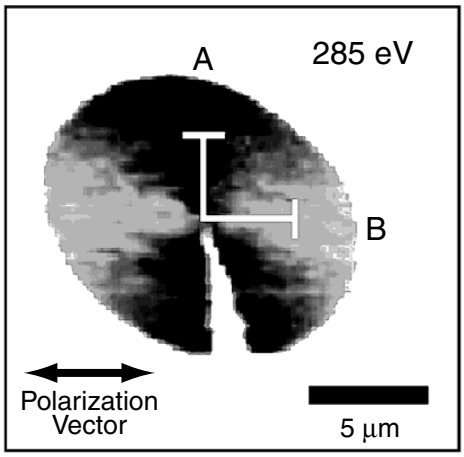
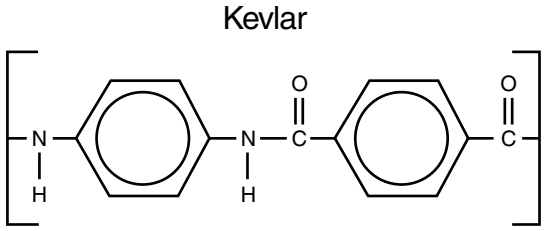
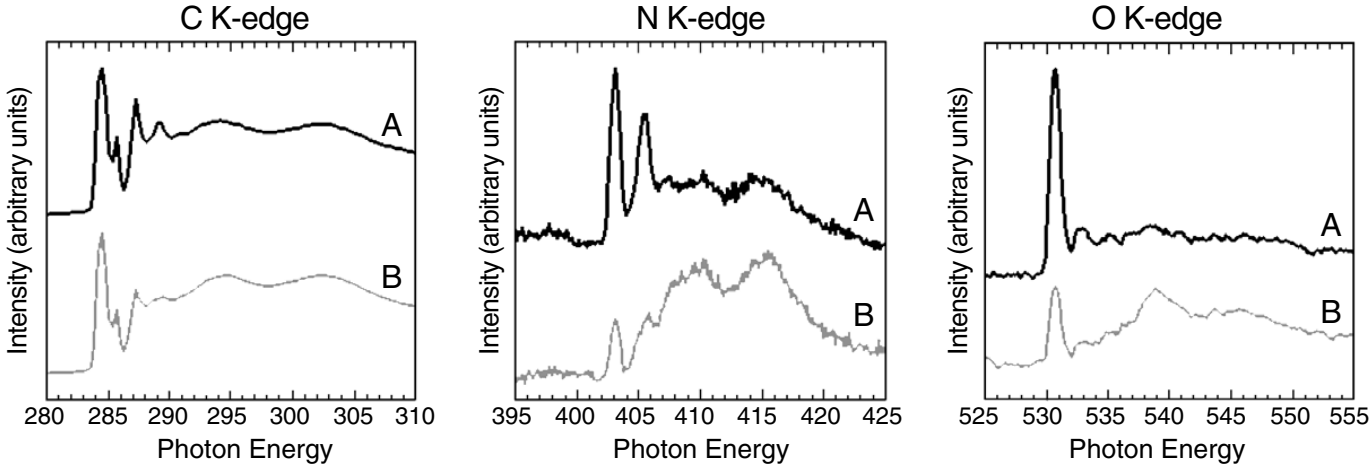
The instrument operates over the photon energy range from 180 to 900 eV with a spectral resolving power up to 5000 and count rates up to 10 MHz. NEXAFS spectra are acquired with the sample fixed, while the photon energy is scanned by means of the beamline monochromator. Owing to the wavelength dependence of the focal distance of the zone plate, the stage must also translate longitudinally for spectral scans.

Transmission measurements are made in helium at atmospheric pressure. Wet or dirty samples are acceptable. The sample thickness should be up to about three absorption lengths at the absorption edge, typically about 100 nm for organic materials. Thin films deposited on silicon nitride windows can be examined and transmission cells containing liquid or hydrated samples between silicon nitride windows have been employed.

A typical scenario might consist of a conventional spectroscopic examination to locate characteristic spectral features, followed by a mapping of the distribution of those features at coarse resolution, a finer mapping of areas of interest, and a detailed spectroscopic examination of the most important features. ■







Carbon K-edge image of a sectioned Kevlar fiber *taken by STXM together with NEXAFS spectra at the K edges of carbon, nitrogen, and oxygen obtained from two different portions of the fiber (A and B). The radial structure of the fiber gives rise to a changing orientation between the polarization of the undulator light and the molecular orbitals in the fiber, resulting in the distinctive image and the differences in the spectra. Data courtesy of H. Ade and A. Garcia (North Carolina State University).*

This endstation is available to independent investigators by submitting a proposal.

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